"The Development of a New Four-year Construction Technology and Management Stream at QUT".

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Abstract

This paper focuses on the development and delivery of a core construction management (CM) unit, which forms the capstone of a four-unit CM stream in an undergraduate programme in the Faculty of Built Environment and Engineering at the Queensland University of Technology. UDB410 (*Construction Management*) is a final year unit that consolidates skills students have learned throughout their degree, hopefully graduating them as work-ready construction managers. It was developed in consultation with the Queensland Chapter of the Australian Institute of Building (AIB) and is a final year unit in the undergraduate Bachelor of Urban Development (CM) course. The unit uses various tools such as the OSIRIS business database (Bureau van Dijk Electronic Publishing, 2009), the AROUSAL (UK Version) construction business simulation (Lansley, 2009) and the Denison Organisational Culture Survey (Denison, 2000) to facilitate the development of skills in managing a construction company.

The objectives of the paper are:

- To track the rationale and development of the UDB410 unit sand describe the way in which this final year unit integrates learning from other parts of the course within which it is located as well as capping-off the CM stream of core units;
- To highlight the difficulties of blending a balance of technology and management in a single unit; and
- To explain how partnering with the construction industry benefited the learning quality of the unit.

Keywords: construction management, undergraduate curriculum, industry-sought skills, organisational culture.

Introduction

In 2005, the Faculty of Built Environment and Engineering at Queensland University of Technology introduced a new UD40 Bachelor of Urban Development (Construction Management) undergraduate course. This new course replaced the CN51 Bachelor of Construction Management (CM) course that had been running success fully for some 10 years. In discussions with the AIB, it was felt there should be more strategic management teaching at the back end of the course to balance out the heavy emphasis on technology at the front end and middle of the course. In the new course, there was to be one specific flagship CM unit in each of the four years of the course as follows:

Year 1 – Residential Construction and Engineering (UDB110)
Year 2 – Commercial Construction and Engineering (UDB210)
Year 3 – High Rise Construction and Engineering (UDB310)
Year 4 – Construction Management (UDB410)

After discussions amongst the teaching team, the generic model shown in Figure 1 was adopted as the basic framework for the four core CM units and the overall UD40 course structure is shown in Figure 2.

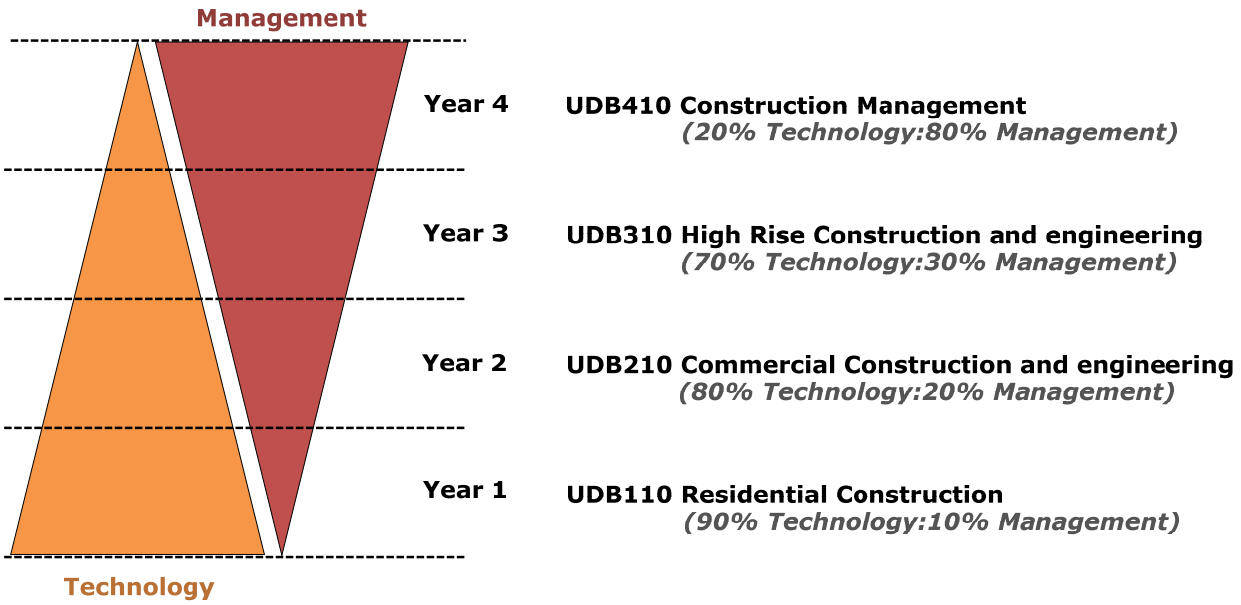

Figure 1 – Diagram showing progression of UDBX10 Units (Source: Coffey and Smit, 2009)

Whilst UDB110 and 210 were initially designed to transfer from old to new courses relatively unchanged, UDB310 running for the first time in 2007, whilst delivering similar content to its predecessor, was populated with a lecture team of guest experts drawn from local construction companies, specialist materials organisations and suppliers/subcontractors. Each lecture took the form of a topic introduction by a QUT fulltime academic from the CM teaching team, a guest lecture and ended with a topic context related weekly workbook problem designed to be researched and written up in a comprehensive report handed in at the completion of the semester.

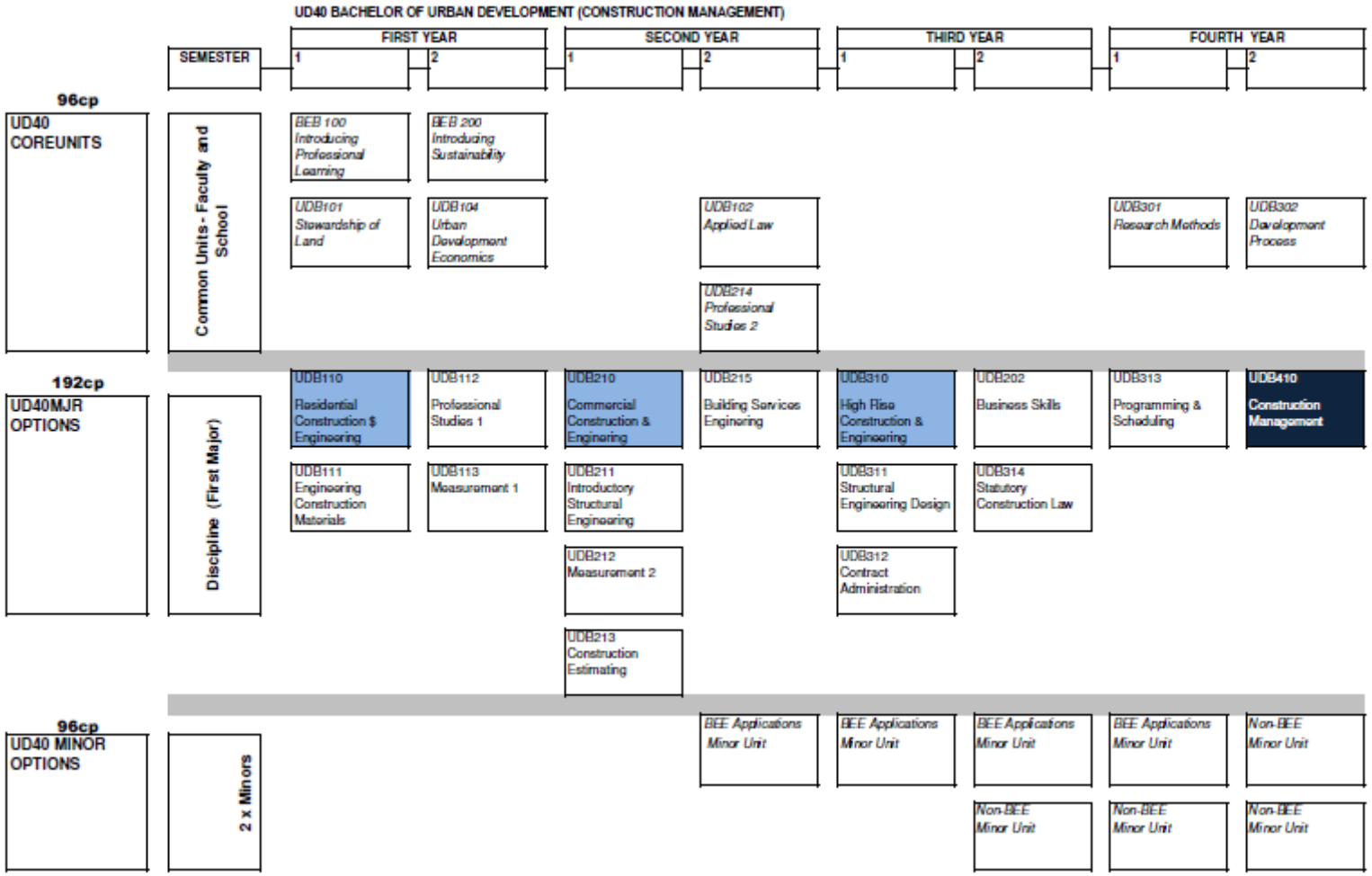

Figure 2 – UD40 Course Structure

This major assignment was backed up with weekly short quizzes and an end-of-semester examination. This structure is now undergoing its second offering and has proven to be popular with students drawing some excellent comments in the Learning Experience Survey (LEX) undertaken at the end of every semester for every unit delivery, a critical component of QUT's teaching quality management plan.

Concept of the Prototype Fourth Year Unit (2007 version)

Having successfully launched the first three core CM units, it then became time to strategically plan and develop the last of these units for the fourth year students who would graduate from the new course. So as not to rush this all-important enterprise and in order to rationalise the design and undertake a trial-run of much of the content for the new unit, it was decided to use an existing fourth year elective unit (Current Construction Issues) as a prototype for at least one to two years before finalising UDB410. Two members of the CM teaching team collaborated to co-coordinate the prototype unit and the first step was to discuss the proposed unit content with the AIB who are the course accreditation body for UD40. It was also necessary to consider certain key demographics of the first batch of students to enrol in the prototype unit, as follows:

- 75 - 80% of the students were working as building or QS cadets
- It had been noted from earlier discussions in year three with a large proportion of the intended new unit students that not many students actually had a detailed knowledge of the companies they worked in and therefore it was felt necessary to design a curriculum that would not only explore strategic construction management concepts but also to design in a major assignment which ensured that students would have an opportunity to explore the workings of their own and other companies in a real world context.
- When discussing some of the intended unit content with the students that would enter it, it became clear that the concept and importance of organisational culture was not well understood and students couldn't fully comprehend how it related to their workplace, what its relationship with organisational effectiveness and business success might be or indeed how such concepts could be made real or quantifiable.

After reflecting on these issues, the co-coordinators decided on the following goals to be added to the existing graduate capabilities and learning outcomes for the 2007 run of the revised existing elective:

- Give students an individual assignment to investigate and set out a detailed profile of their company (or a pre-given company for those not working)
- Support with lectures on organisational structure and culture
- Introduce students to an instrument for measuring the strength of organisational culture and encourage them to obtain up to 25 survey responses from within their own organisations.

- Support with lectures on organisational culture and effectiveness metrics and measurement instruments, quality management, performance management, key performance indicators (KPIs), etc.
- Get students in groups to compare and use the data obtained from this research to better understand and articulate the well-established concept that a relationship exists between strong organisational culture and effectiveness in business operation and then relate what they had learned in group presentations.

Methodology

As one of the unit co-coordinators was experienced in using, and analysing the results from, a US developed organizational culture survey instrument, it was decided to allow students to use this to attempt to measure the culture and its strength within their own companies. Figure 3 shows the generic version of the Denison Organisational Culture model (Denison, 2000) , which was developed by Professor Daniel Denison and William Neale (2000) and has been used in over 4000 companies to measure and analyse organisational culture since its original development.

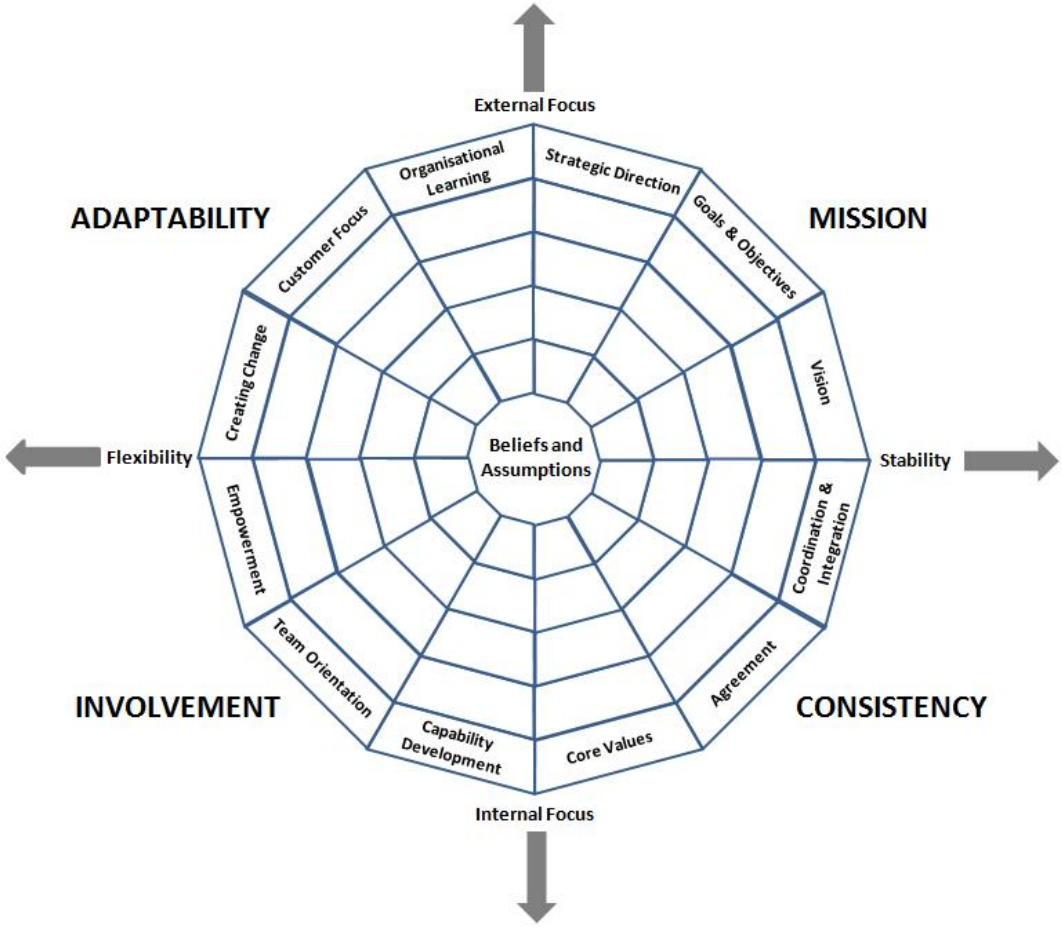

Figure 3 - Denison Organisational Culture Survey (DOCS) Model (Source: Denison Consulting Group, 2009 adapted by Coffey, 2009)

As part of the profiling exercise of their companies, students were asked to capture basic information such as year of establishment, number of employees, type/size/value of contracts handled and any basic KPIs operated by the company to set targets for best practice and measure achievement against them. Early on in the semester, the earlier issue raised with the students when the assignment was first discussed in class arose again, namely that most students found it virtually impossible to obtain accurate or meaningful information on any internal KPIs that their companies operated or were prepared to disclose. This led to a renegotiation as to how effectiveness could be measured and it was quickly decided to switch to a subjective self-measuring device developed for use within business situations to capture perceived performance now and aspired to performance in the future to at least give a feel of how effectively respondents with in companies felt it was operating and performing. The students named this instrument, the "train track" chart and the original version is shown in Figure 4.

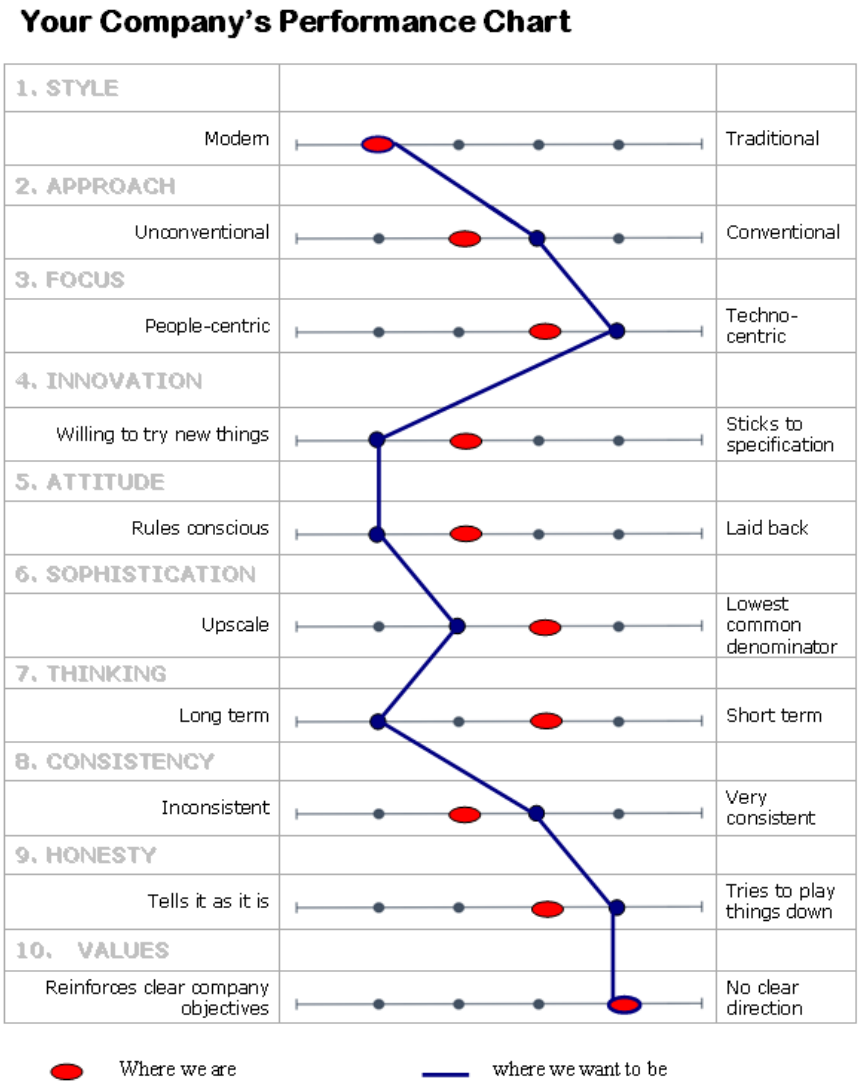

Figure 4 – Self-assessed Performance Chart (Source: Williams, 2007)

Because of the time constraints for the assignment and in order to develop some ‘tools’ to support student efforts in using the Denison and train track model, a sessional information technology expert was engaged to develop some enhancements to MS Excel spreadsheet software that would semi-automate some of the chart drawing work based on the data inserted into the spreadsheet by the students. The output from this software programme developed by a QUT sessional staff member is shown in Figure 5. As mentioned previously, students were asked to collect up to 25 surveys, part of the Criterion Referenced Assessment for the assignment was based on the number of surveys collected (although this was not highly weighted). Once students had generated their simplified spider-graph version of the Denison model and their train tracks model for their own company, they compared their results with those of others and analysed their findings supported by the co-coordinators. Working in groups, the students then produced a draft report and gave a presentation to an adjudication panel made up of the co-coordinators and some invited academics. Examples of a typical train tracks model and spider-graph result are shown in Figures 5 and 6.

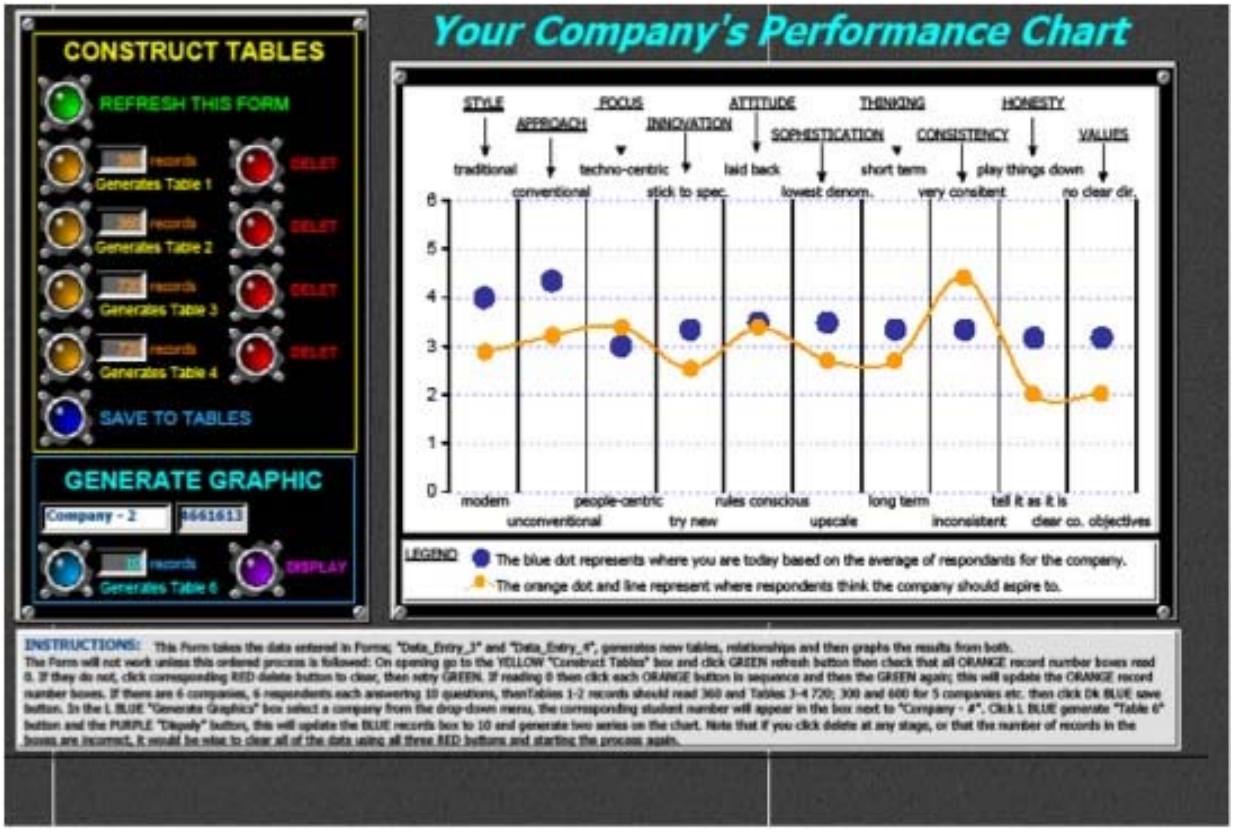

Figure 5 – Macro-assisted Performance Chart (Source: Gutteridge, 2007)

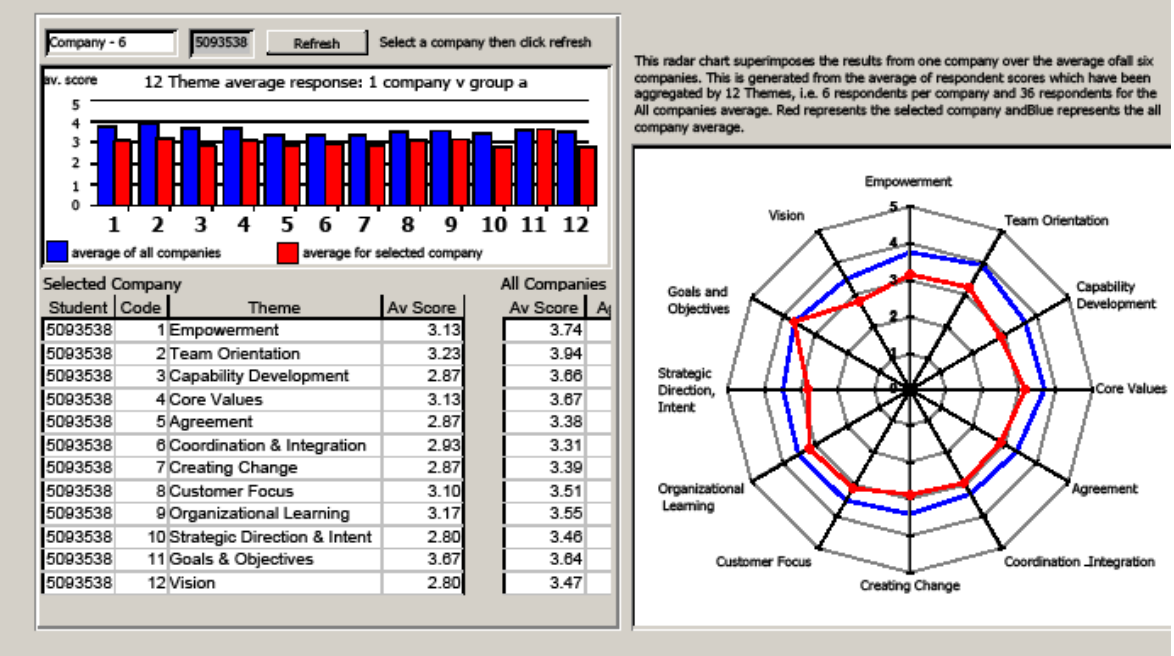

Figure 6 Example of DOCS indices and spider-graph (Gutteridge, 2007)

Using the feedback obtained from the presentation and from the co-coordinators, students then finalised their report and submitted it at the end of the semester. The instructions for this assignment were as follows:

A. Written Presentation (individual)

As individuals, you will undertake a survey and some interviews (the survey instrument and semi-structured interview questions will be provided to you) and prepare a short 2000 word Summary Report of your perception of your own company's/a given company's state of organisational culture (we will call this an initial health check). Your lecturer will assess your report and give you helpful feedback to assist you to move forward to the next task in the unit.

Due date: Start of Week 6 lectures
Weight: 20%

B. Verbal Presentation (group)

As a group of five to seven students, you will share the data from your first assignment referred to above and together analyse the results drawn from this data based on what you have been taught and have learned in earlier lectures and/or tutorials and from your recommended reading. You will research findings using some basic statistical software (tuition in the use of software will be provided) from the results and after discussion prepare a summary of your findings and an outline for your final report and present that material to a panel of judges and an outline of your final report by means of a short executive summary and a multimedia presentation. The purpose of this presentation is to enable the judges to gain a clear idea of the quality of your

understanding of the issues that you have researched as well as your capability to work in a team-setting. The judges' panel will assess your materials and give you helpful feedback at the end of your group's presentation. Preparing for and delivering this presentation will assist you to produce your final report.

Due date: Start of week 10 lectures
Weight: 30%

C. Final Report (group)

Your group will submit its final report using Assignment Minder with your multimedia presentation attached to it on a CD-ROM.

Due date: End of Semester
Weight: 50%

Outcomes of the 2007 Unit

Several of the final reports were of excellent quality, but feedback derived from the subsequent LEX survey indicated that students had found the assignment somewhat difficult, in particular, collecting their own company demographic data and utilising the software (designed to assist them!) and in analysing the results of their research. The co-coordinators used this feedback to propose alterations to the first prototype unit and the adjustments made are described in the next section of this paper.

The Rebuilt Unit (2008 version)

The following improvements were made to the next offering of the unit and it was agreed not to convert this to the full UDB410 version until a better balance could be struck between unit goals, content and assessment:

A formalised template was given to students in order to help them obtain a more accurate profile of their companies and the template was set out as follows:

- *Name and contact details of company* (include local address, phone numbers, website URL address, etc.)
- *Type of company* (maximum one line description only)
- *Background history* (Maximum 100 words and flowcharts are required for mergers, takeovers)
- *Summary of company mission statement* (Maximum 50 words)
- *Organisational chart showing local office setup (structure*, lines of responsibility, e.g. HR, contracts, safety, etc.)

- *Type of work handled* (maximum one line description only stating predominant focus e.g. QS or medium size construction company)
- *Type/s of procurement your company engages in mostly, eg. ,lump sum, construction management, alliancing, design and construct etc?* (List the projects for 2005 to 2008 in a table as shown below)
- *Business results table* (extract figures from annual report):
- *Awards (has the company won any awards – safety, best employer, etc?)* (list only – one line per award)
- *Is the company ISO–certified, if so to which standards* (e.g. Quality-ISO900, Environmental-ISO14001, Safety ISO18001, etc.)
- *How many value management/value engineering studies/workshops has your company engaged in between 2005-2008* (list only one line per VM/VE event and state subject of study and three bullet points of outcomes for each study) Attach all executive summaries in an appendix to your report.
- *How is your company's business performance/success measured/determined?* (use table of KPIs below)
- *Organisational Culture Surveys and Analysis* (refer to lectures and learning materials on blackboard)
- *Recommendations to improve current organisational culture* (student compiles a summary and categorises answers to this question from all interviewees. Appendix to include all responses obtained)

Additionally a more user-friendly version of the spreadsheet software and automated charting function was developed which students appeared to be able to work with much more easily. Interviews were held with all students to present their draft profile and culture report between weeks 5-7. The exercise was conducted individually and the students were interviewed by both co-coordinators on a one to one basis and detailed feedback/advice was given to them in order to assist with their analysis of data and greater understanding of the context and relevance of what they were researching was imparted. The final individual report by students was handed in by week 8 of semester and marks posted by week 9.

Thinking ahead to the eventual structure of the finalised version of the flagship unit, the UK-based version of the building simulation game AROUSAL (Lansley, 2003) was introduced to students during week 8 and the software was demonstrated and briefing documents handed out and students self-organised into groups sized between 8 – 10 persons. We ran the AROUSAL simulation on a whole Saturday at the end of week 9. Students presented a debriefing on the outcomes of their group's running and results from the simulation between weeks 10-13 and al marks for the unit were finalised in Week 13.

Outcome

The introduction of the company profile template, improved software for the organisational culture component of the first assignment and the dropping of inter-company comparison were

well-received by students and the one-to-one interview sessions were considered by students to be outstanding feedback and of benefit to their better understanding of the important concepts of company culture, effectiveness and in many cases gave them a greater perspective on how their companies operated and were organised.

AROUSAL was a very popular activity with students once they got into the simulation and many stayed later than the prescribed 5pm cut-off as they wanted to run the simulation a second time to improve their company results. The standard of the debriefing presentations was extremely good and only a minority of groups put minimal effort into this part of the AROUSAL-based assignment. A particularly satisfying outcome was that some of the better groups linked together the strategic reasoning behind the setting of the organisational culture and AROUSAL assignments and felt both would help them significantly in their future working life in their companies. However, it seems to be a fact that generally undergraduate students prefer not to work on group exercises if marks are at stake.

Launching the Improved Unit (2009 – Semester 2)

Further discussions have taken place with members of the local Queensland chapter committee of AIB on the exact structure of the UDB410 which will be launched next semester. From these discussions, additional topics of strategic importance to construction management students about to graduate from the course have been added, in particular an enhanced understanding of safety and the new workplace legislation have been proposed. Although AROUSAL will still feature as an exercise within the unit, it will be not be graded as part of the overall culture and KPI profiling assignment but will be used as a tool to integrate the inherent knowledge of the various aspects of running a building company that students should have in mind by the time of reaching their final course year and semester and also to exhibit the benefits of team working in a more neutralised setting (i.e. marks are not at stake – just healthy competitive outcomes). The schedule of assessment now looks like this:

A. Assessment 1 (individual)
Prepare a safety risk assessment and a work method statement focusing on a high risk activity for a major project.

Weighting**:** 20%
Due: Week 5

B. Assessment 2 (individual)
Students will compile a report on the organisation and management of their building company

Weighting: 30%
Due: Week 10

C. Assessment 3 (individual)
Final Exam

Weighting: 50%
Due: QUT Examination Period

Some further work is being undertaken on fully automating the organisational culture measuring/charting software and on further developing the profile more as a checklist to make it more comprehensive whilst ensuring it is straight forward to fill in. In particular, more information on KPIs and business success measures will be included and the OSIRIS business software system is being trialled by the QUT library which students will be encouraged to use to establish an accurate picture of their own company performance for use in the exercise. The output from this new Denison survey is shown in Figure 7.

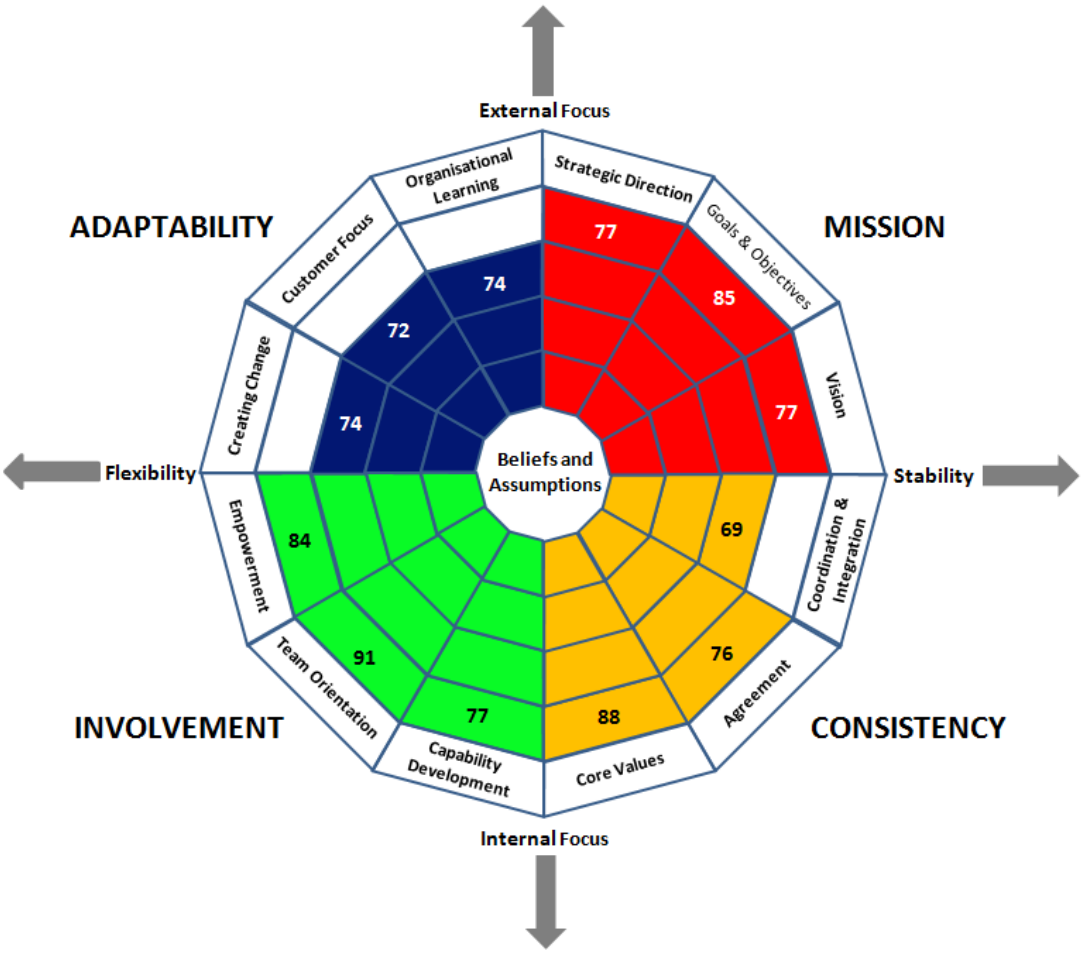

Figure 7 - DOCS Model graph used for 2008 QUT Survey Results (Source: Coffey, 2009)

This now completes a stream of four core CM units and UDB410 is now structured as follows:

Week	Lecture Schedule
1	Project Process Management
2	Plant management and Safety & risk Assessment
3	Project procurement /Industrial Relations
4	Advanced estimating and tendering
5	Competitive bidding
6	Budgetary control
7	Cash flow & interim valuations and economics
8	Company organisation, Market planning and business development and International logistics
9	AROUSAL
10	Student Presentations on Assignment 2 (wk 1 of 2)
11	Student Presentations on Assignment 2 (wk 2 of 2)
12	Information resources and ICT systems
13	Financial management

Conclusion

Clearly, this has not been a conventional research paper but more an ordered narrative to share with colleagues at AUBEA 2009 on the trials and tribulations of building a suite of CM core units following a significant change of course structure. It is hoped that the following benefits of the methodology adopted have become obvious to the reader as the story has unfolded:

- It is imperative for a university to work closely with the industry into which graduates will step out following completion of their four to five years of study to ensure that they possess the skills, knowledge and potential expertise to be immediately useful to that industry.
- Prototyping of new units (where time permits) is essential to ensure that the correct balance between planned outcomes, the student experience and dissemination of strategic knowledge is achieved following the running of the unit.
- Collecting and incorporating student feedback into developing a new latter-course stage unit is critical for its success and sustainability.
- Linking strategic theories and perspectives to real-world scenarios in a semi-research setting actually allows students to better relate the two paradigms and hopefully will remain in their memories much longer than if delivered in a non-linked independent fashion, and,
- Keeping units interesting, engaging and fun is not just a prerogative of early-course education, as maybe was historically though to be the case, but is possibly even more beneficial when students have already achieved a deep level of technological understanding and have attained the maturity of perspective necessary to link in strategic thinking about how to manage not only the technology, but the human resources and organisational complexities often found within their industries.

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